



# CY74FCT16500T CY74FCT162500T

## 18-Bit Registered Transceiver

### Features

- Low power, pin compatible replacement for ABT functions
- FCT-C speed at 4.6 ns
- Power-off disable outputs permits live insertion
- Edge-rate control circuitry for significantly improved noise characteristics
- Typical output skew < 250 ps
- ESD > 2000V
- TSSOP (19.6-mil pitch) and SSOP (25-mil pitch) packages
- Industrial temperature range of -40°C to +85°C
- $V_{CC} = 5V \pm 10\%$

#### CY74FCT16500T Features:

- 64 mA sink current, 32 mA source current
- Typical  $V_{OLP}$  (ground bounce) <1.0V at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$

#### CY74FCT162500T Features:

- Balanced 24 mA output drivers
- Reduced system switching noise
- Typical  $V_{OLP}$  (ground bounce) <0.6V at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$

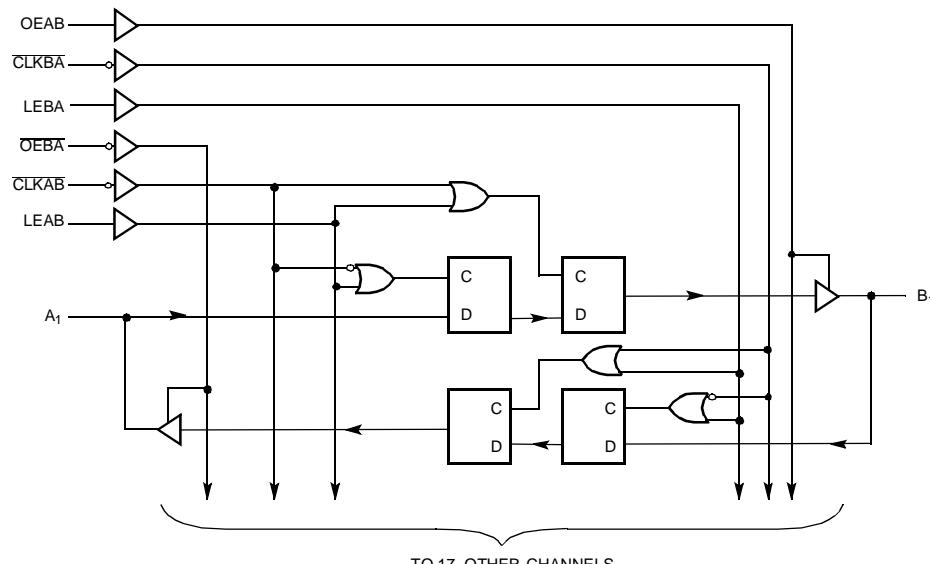
### Functional Description

These 18-bit universal bus transceivers can be operated in transparent, latched, or clock modes by combining D-type latches and D-type flip-flops. Data flow in each direction is controlled by output-enable ( $OEAB$  and  $\bar{OEBA}$ ), latch enable ( $LEAB$  and  $LEBA$ ), and clock inputs ( $CLKAB$  and  $\bar{CLKBA}$ ) inputs. For A-to-B data flow, the device operates in transparent mode when  $LEAB$  is HIGH. When  $LEAB$  is LOW, the A data is latched if  $CLKAB$  is held at a HIGH or LOW logic level. If  $LEAB$  is LOW, the A bus data is stored in the latch/flip-flop on the HIGH-to-LOW transition of  $CLKAB$ .  $OEAB$  performs the output enable function on the B port. Data flow from B-to-A is similar to that of A-to-B and is controlled by  $\bar{OEBA}$ ,  $LEBA$ , and  $CLKBA$ . The output buffers are designed with power-off disable feature that allows live insertion of boards.

The CY74FCT16500T is ideally suited for driving high-capacitance loads and low-impedance backplanes.

The CY74FCT162500T has 24-mA balanced output drivers with current limiting resistors in the outputs. This reduces the need for external terminating resistors and provides for minimal undershoot and reduced ground bounce. The CY74FCT162500T is ideal for driving transmission lines.

### Logic Block Diagram



FCT16500-1

### Pin Configuration

| SSOP/TSSOP<br>Top View |     |
|------------------------|-----|
| OEAB                   | 1   |
| LEAB                   | 2   |
| A <sub>1</sub>         | 3   |
| GND                    | 4   |
| A <sub>2</sub>         | 5   |
| A <sub>3</sub>         | 6   |
| V <sub>CC</sub>        | 7   |
| A <sub>4</sub>         | 8   |
| A <sub>5</sub>         | 9   |
| A <sub>6</sub>         | 10  |
| GND                    | 11  |
| A <sub>7</sub>         | 12  |
| A <sub>8</sub>         | 13  |
| A <sub>9</sub>         | 14  |
| A <sub>10</sub>        | 15  |
| A <sub>11</sub>        | 16  |
| A <sub>12</sub>        | 17  |
| GND                    | 18  |
| A <sub>13</sub>        | 19  |
| A <sub>14</sub>        | 20  |
| A <sub>15</sub>        | 21  |
| V <sub>CC</sub>        | 22  |
| A <sub>16</sub>        | 23  |
| A <sub>17</sub>        | 24  |
| GND                    | 25  |
| A <sub>18</sub>        | 26  |
| OEBA                   | 27  |
| LEBA                   | 28  |
|                        | 56  |
|                        | 55  |
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|                        | 32  |
|                        | 31  |
|                        | 30  |
|                        | 29  |
|                        | GND |

FCT16500-2

## Pin Summary

| Name  | Description                                      |
|-------|--|
| OEAB  | A-to-B Output Enable Input                       |
| OEBA  | B-to-A Output Enable Input (Active LOW)          |
| LEAB  | A-to-B Latch Enable Input                        |
| LEBA  | B-to-A Latch Enable Input                        |
| CLKAB | A-to-B Clock Input (Active LOW)                  |
| CLKBA | B-to-A Clock Input (Active LOW)                  |
| A     | A-to-B Data Inputs or B-to-A Three-State Outputs |
| B     | B-to-A Data Inputs or A-to-B Three-State Outputs |

## Function Table<sup>[1, 2]</sup>

| Inputs |      |       |   | Outputs          |
|--------|------|-------|---|------------------|
| OEAB   | LEAB | CLKAB | A | B                |
| L      | X    | X     | X | Z                |
| H      | H    | X     | L | L                |
| H      | H    | X     | H | H                |
| H      | L    | ¬L    | L | L                |
| H      | L    | ¬L    | H | H                |
| H      | L    | H     | X | B <sup>[3]</sup> |
| H      | L    | L     | X | B <sup>[4]</sup> |

## Electrical Characteristics Over the Operating Range

| Parameter        | Description   | Test Conditions   | Min. | Typ. <sup>[7]</sup> | Max. | Unit |
|------------------|---|---|------|---------------------|------|------|
| V <sub>IH</sub>  | Input HIGH Voltage                                      |   | 2.0  |                     |      | V    |
| V <sub>IL</sub>  | Input LOW Voltage                                       |   |      |                     | 0.8  | V    |
| V <sub>H</sub>   | Input Hysteresis <sup>[8]</sup>                         |   |      | 100                 |      | mV   |
| V <sub>IK</sub>  | Input Clamp Diode Voltage                               | V <sub>CC</sub> =Min., I <sub>IN</sub> =-18 mA              |      | -0.7                | -1.2 | V    |
| I <sub>IH</sub>  | Input HIGH Current                                      | V <sub>CC</sub> =Max., V <sub>I</sub> =V <sub>CC</sub>      |      |                     | ±1   | µA   |
| I <sub>IL</sub>  | Input LOW Current                                       | V <sub>CC</sub> =Max., V <sub>I</sub> =GND.                 |      |                     | ±1   | µA   |
| I <sub>OZH</sub> | High Impedance Output Current (Three-State Output pins) | V <sub>CC</sub> =Max., V <sub>OUT</sub> =2.7V               |      |                     | ±1   | µA   |
| I <sub>OZL</sub> | High Impedance Output Current (Three-State Output pins) | V <sub>CC</sub> =Max., V <sub>OUT</sub> =0.5V               |      |                     | ±1   | µA   |
| I <sub>OS</sub>  | Short Circuit Current <sup>[9]</sup>                    | V <sub>CC</sub> =Max., V <sub>OUT</sub> =GND                | -80  | -140                | -200 | mA   |
| I <sub>O</sub>   | Output Drive Current <sup>[9]</sup>                     | V <sub>CC</sub> =Max., V <sub>OUT</sub> =2.5V               | -50  |                     | -180 | mA   |
| I <sub>OFF</sub> | Power-Off Disable                                       | V <sub>CC</sub> =0V, V <sub>OUT</sub> <4.5V <sup>[10]</sup> |      |                     | ±1   | µA   |

### Notes:

1. H = HIGH Voltage Level. L = LOW Voltage Level. X = Don't Care. Z = HIGH Impedance. ¬L = HIGH-to-LOW Transition.
2. A-to-B data flow is shown, B-to-A data flow is similar but uses OEBA, LEBA, and CLKBA.
3. Output level before the indicated steady-state input conditions were established.
4. Output level before the indicated steady-state input conditions were established, provided that CLKAB was LOW before LEAB went LOW.
5. Operation beyond the limits set forth may impair the useful life of the device. Unless otherwise noted, these limits are over the operating free-air temperature range.
6. Unused inputs must always be connected to an appropriate logic voltage level, preferably either V<sub>CC</sub> or ground.
7. Typical values are at V<sub>CC</sub>=5.0V, T<sub>A</sub>=+25°C ambient.
8. This parameter is guaranteed but not tested.
9. Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high-speed test apparatus and/or sample and hold techniques are preferable in order to minimize internal chip heating and more accurately reflect operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parametric tests. In any sequence of parameter tests, I<sub>OS</sub> tests should be performed last.
10. Tested at +25°C.

## Maximum Ratings<sup>[5, 6]</sup>

(Above which the useful life may be impaired. For user guidelines, not tested.)

|  |                                       |
|--|---------------------------------------|
| Storage Temperature .....                          | Com'l -55°C to +125°C                 |
| Ambient Temperature with Power Applied.....        | Com'l -55°C to +125°C                 |
| DC Input Voltage .....                             | -0.5V to +7.0V                        |
| DC Output Voltage .....                            | -0.5V to +7.0V                        |
| DC Output Current (Maximum Sink Current/Pin) ..... | -60 to +120 mA                        |
| Power Dissipation .....                            | 1.0W                                  |
| Static Discharge Voltage .....                     | >2001V (per MIL-STD-883, Method 3015) |

## Operating Range

| Range      | Ambient Temperature | V <sub>CC</sub> |
|------------|---------------------|-----------------|
| Industrial | -40°C to +85°C      | 5V ± 10%        |



### Output Drive Characteristics for CY74FCT16500T

| Parameter       | Description         | Test Conditions                                | Min. | Typ. <sup>[7]</sup> | Max. | Unit |
|-----------------|---------------------|--|------|---------------------|------|------|
| V <sub>OH</sub> | Output HIGH Voltage | V <sub>CC</sub> =Min., I <sub>OH</sub> =-3 mA  | 2.5  | 3.5                 |      | V    |
|                 |                     | V <sub>CC</sub> =Min., I <sub>OH</sub> =-15 mA | 2.4  | 3.5                 |      |      |
|                 |                     | V <sub>CC</sub> =Min., I <sub>OH</sub> =-32 mA | 2.0  | 3.0                 |      |      |
| V <sub>OL</sub> | Output LOW Voltage  | V <sub>CC</sub> =Min., I <sub>OL</sub> =64 mA  |      | 0.2                 | 0.55 | V    |

### Output Drive Characteristics for CY74FCT162500T

| Parameter        | Description                        | Test Conditions   | Min. | Typ. <sup>[7]</sup> | Max. | Unit |
|------------------|------------------------------------|---|------|---------------------|------|------|
| I <sub>ODL</sub> | Output LOW Current <sup>[9]</sup>  | V <sub>CC</sub> =5V, V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> =1.5V | 60   | 115                 | 150  | mA   |
| I <sub>ODH</sub> | Output HIGH Current <sup>[9]</sup> | V <sub>CC</sub> =5V, V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> =1.5V | -60  | -115                | -150 | mA   |
| V <sub>OH</sub>  | Output HIGH Voltage                | V <sub>CC</sub> =Min., I <sub>OH</sub> =-24 mA  | 2.4  | 3.3                 |      | V    |
| V <sub>OL</sub>  | Output LOW Voltage                 | V <sub>CC</sub> =Min., I <sub>OL</sub> =24 mA   |      | 0.3                 | 0.55 | V    |

**Capacitance<sup>[8]</sup>** (T<sub>A</sub> = +25°C, f = 1.0 MHz)

| Parameter        | Description        | Test Conditions       | Typ. <sup>[7]</sup> | Max. | Unit |
|------------------|--------------------|-----------------------|---------------------|------|------|
| C <sub>IN</sub>  | Input Capacitance  | V <sub>IN</sub> = 0V  | 4.5                 | 6.0  | pF   |
| C <sub>OUT</sub> | Output Capacitance | V <sub>OUT</sub> = 0V | 5.5                 | 8.0  | pF   |

### Power Supply Characteristics

| Parameter        | Description                                      | Test Conditions  | Typ. <sup>[7]</sup>  | Max. | Unit                 |        |
|------------------|--|--|--|------|----------------------|--------|
| I <sub>CC</sub>  | Quiescent Power Supply Current                   | V <sub>CC</sub> =Max.  | V <sub>IN</sub> ≤0.2V,<br>V <sub>IN</sub> ≥V <sub>CC</sub> -0.2V | 5    | 500                  | μA     |
| ΔI <sub>CC</sub> | Quiescent Power Supply Current (TTL inputs HIGH) | V <sub>CC</sub> =Max.  | V <sub>IN</sub> =3.4V <sup>[11]</sup>                            | 0.5  | 1.5                  | mA     |
| I <sub>CCD</sub> | Dynamic Power Supply Current <sup>[12]</sup>     | V <sub>CC</sub> =Max., One Input Toggling, 50% Duty Cycle, Outputs Open, OEAB=OEBA=V <sub>CC</sub> or GND  | V <sub>IN</sub> =V <sub>CC</sub> or V <sub>IN</sub> =GND         | 75   | 120                  | μA/MHz |
| I <sub>C</sub>   | Total Power Supply Current <sup>[13]</sup>       | V <sub>CC</sub> =Max., f <sub>0</sub> =10 MHz (CLKAB), f <sub>1</sub> =5 MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling, OEAB=OEBA=V <sub>CC</sub> LEAB=GND | V <sub>IN</sub> =V <sub>CC</sub> or V <sub>IN</sub> =GND         | 0.8  | 1.7                  | mA     |
|                  |  |  | V <sub>IN</sub> =3.4V or V <sub>IN</sub> =GND                    | 1.3  | 3.2                  | mA     |
|                  |  | V <sub>CC</sub> =Max., f <sub>0</sub> =10 MHz, f <sub>1</sub> =2.5 MHz, 50% Duty Cycle, Outputs Open, Eighteen Bits Toggling, OEAB=OEBA=V <sub>CC</sub> LEAB=GND | V <sub>IN</sub> =V <sub>CC</sub> or V <sub>IN</sub> =GND         | 3.8  | 6.5 <sup>[14]</sup>  | mA     |
|                  |  |  | V <sub>IN</sub> =3.4V or V <sub>IN</sub> =GND                    | 8.5  | 20.8 <sup>[14]</sup> | mA     |

#### Notes:

11. Per TTL driven input (V<sub>IN</sub>=3.4V); all other inputs at V<sub>CC</sub> or GND.  
12. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.

13.  $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD}(f_0/2 + f_1 N_1)$   
 $I_{CC}$  = Quiescent Current with CMOS input levels  
 $\Delta I_{CC}$  = Power Supply Current for a TTL HIGH input (V<sub>IN</sub>=3.4V)  
 $D_H$  = Duty Cycle for TTL inputs HIGH  
 $N_T$  = Number of TTL inputs at D<sub>H</sub>  
 $I_{CCD}$  = Dynamic Current caused by an input transition pair (HLH or LHL)  
 $f_0$  = Clock frequency for registered devices, otherwise zero  
 $f_1$  = Input signal frequency  
 $N_1$  = Number of inputs changing at f<sub>1</sub>

All currents are in millamps and all frequencies are in megahertz.

14. Values for these conditions are examples of the I<sub>CC</sub> formula. These limits are guaranteed but not tested.



**CY74FCT16500T  
CY74FCT162500T**

### Switching Characteristics Over the Operating Range<sup>[15]</sup>

| Parameter                            | Description  | CY74FCT16500AT/<br>CY74FCT162500AT |      | CY74FCT16500CT/<br>CY74FCT162500CT |      | Unit | Fig.<br>No. <sup>[16]</sup> |
|--------------------------------------|--|------------------------------------|------|------------------------------------|------|------|-----------------------------|
|                                      |  | Min.                               | Max. | Min.                               | Max. |      |                             |
| f <sub>MAX</sub>                     | CLKAB or CLKBA frequency                           |                                    | 150  |                                    | 150  | MHz  |                             |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>A to B or B to A              | 1.5                                | 5.1  | 1.5                                | 4.6  | ns   | 1, 3                        |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>LEBA to A, LEAB to B          | 1.5                                | 5.6  | 1.5                                | 5.3  | ns   | 1, 5                        |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>CLKBA to A, CLKAB to B        | 1.5                                | 5.6  | 1.5                                | 5.3  | ns   | 1, 5                        |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output Enable Time<br>OEBA to A, OEAB to B         | 1.5                                | 6.0  | 1.5                                | 5.4  | ns   | 1, 7, 8                     |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output Disable Time<br>OEBA to A, OEAB to B        | 1.5                                | 5.6  | 1.5                                | 5.2  | ns   | 1, 7, 8                     |
| t <sub>SU</sub>                      | Set-Up Time, HIGH or LOW<br>A to CLKAB, B to CLKBA | 3.0                                |      | 3.0                                |      | ns   | 9                           |
| t <sub>H</sub>                       | Hold Time, HIGH or LOW<br>A to CLKAB, B to CLKBA   | 0                                  |      | 0                                  |      | ns   | 9                           |
| t <sub>SU</sub>                      | Set-Up Time, HIGH or LOW<br>A to LEAB, B to LEBA   | Clock HIGH                         | 3.0  | 3.0                                |      | ns   | 4                           |
|                                      |  | Clock LOW                          | 1.5  | 1.5                                |      | ns   | 4                           |
| t <sub>H</sub>                       | Hold Time, HIGH or LOW<br>A to LEAB, B to LEBA     | 1.5                                |      | 1.5                                |      | ns   | 4                           |
| t <sub>W</sub>                       | LEAB or LEBA Pulse Width HIGH                      | 3.0                                |      | 2.5                                |      | ns   | 5                           |
| t <sub>W</sub>                       | CLKAB or CLKBA Pulse Width HIGH or LOW             | 3.0                                |      | 3.0                                |      | ns   | 5                           |
| t <sub>SK(O)</sub>                   | Output Skew <sup>[17]</sup>                        |                                    | 0.5  |                                    | 0.5  | ns   |                             |

### Ordering Information CY74FCT16500T

| Speed<br>(ns) | Ordering Code     | Package<br>Name | Package Type            | Operating<br>Range |
|---------------|-------------------|-----------------|-------------------------|--------------------|
| 4.6           | CY74FCT16500CTPAC | Z56             | 56-Lead (240-Mil) TSSOP | Industrial         |
|               | CY74FCT16500CTPVC | O56             | 56-Lead (300-Mil) SSOP  |                    |
| 5.1           | CY74FCT16500ATPAC | Z56             | 56-Lead (240-Mil) TSSOP | Industrial         |
|               | CY74FCT16500ATPVC | O56             | 56-Lead (300-Mil) SSOP  |                    |

### Ordering Information CY74FCT162500T

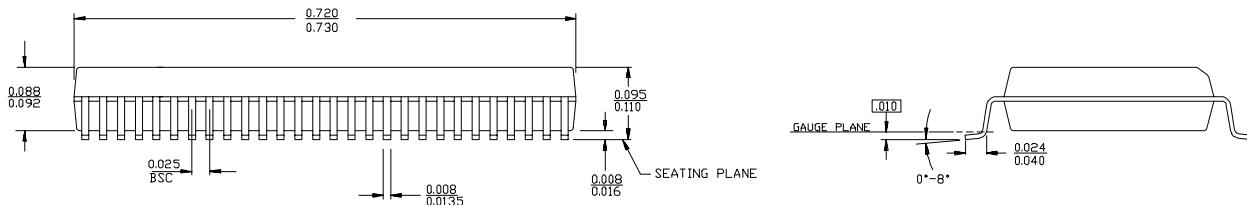
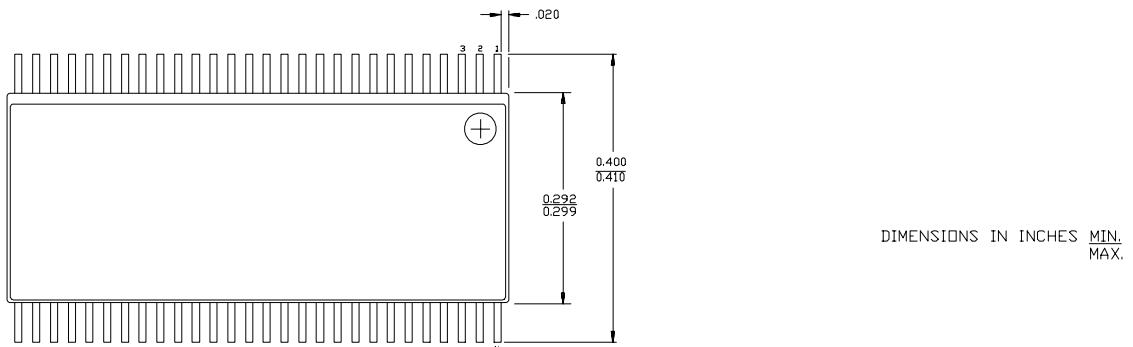
| Speed<br>(ns) | Ordering Code      | Package<br>Name | Package Type            | Operating<br>Range |
|---------------|--------------------|-----------------|-------------------------|--------------------|
| 4.6           | CY74FCT162500CTPAC | Z56             | 56-Lead (240-Mil) TSSOP | Industrial         |
|               | CY74FCT162500CTPVC | O56             | 56-Lead (300-Mil) SSOP  |                    |
| 5.1           | CY74FCT162500ATPAC | Z56             | 56-Lead (240-Mil) TSSOP | Industrial         |
|               | CY74FCT162500ATPVC | O56             | 56-Lead (300-Mil) SSOP  |                    |

#### Notes:

- 15. Minimum limits are guaranteed but not tested on Propagation Delays.
- 16. See "Parameter Measurement Information" in the General Information section.
- 17. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

## Package Diagrams

**56-Lead Shrunk Small Outline Package O56**



**56-Lead Thin Shrunk Small Outline Package Z56**

